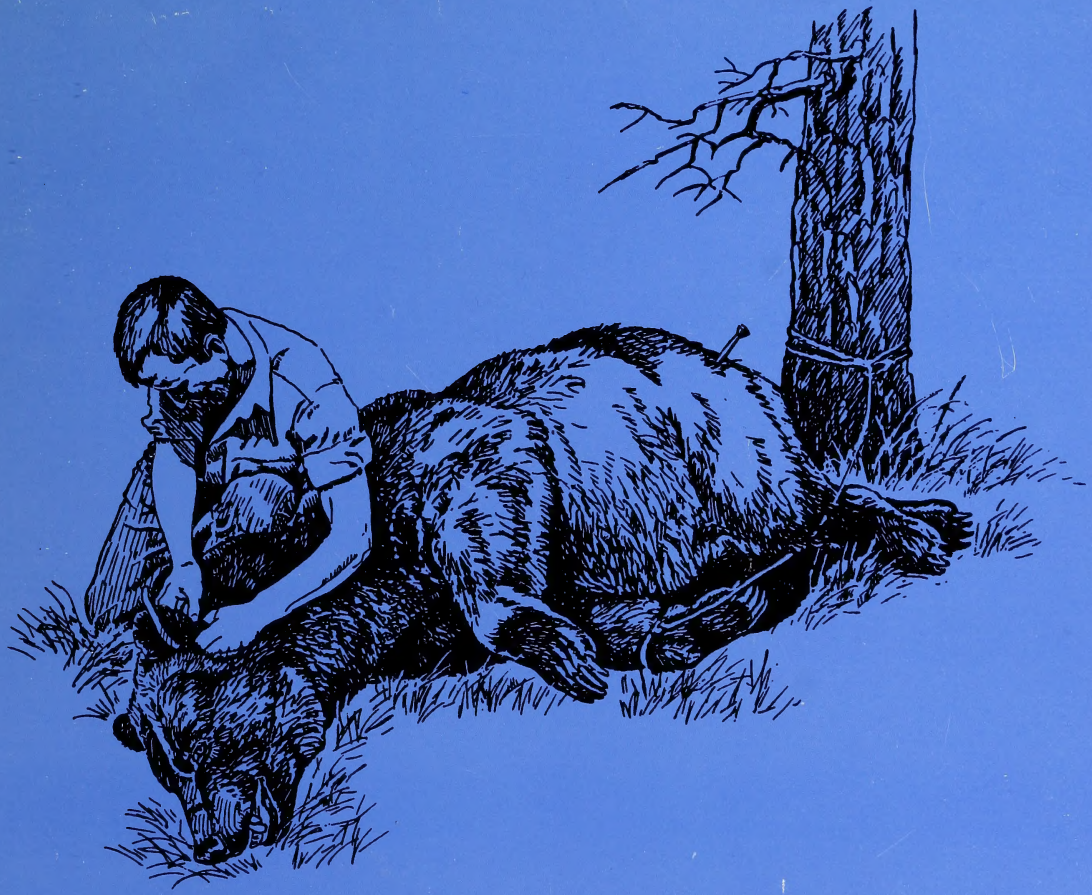
IMMOBILIZATION OF GRIZZLIES WITH KETAMINE - XYLAZINE AND MORPHOMETRICS OF THE BEARS DRUGGED IN KANANASKIS COUNTRY, ALBERTA



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IMMOBILIZATION OF GRIZZLIES WITH KETAMINE–XYLAZINE AND MORPHOMETRICS OF THE BEARS DRUGGED IN KANANASKIS COUNTRY, ALBERTA

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

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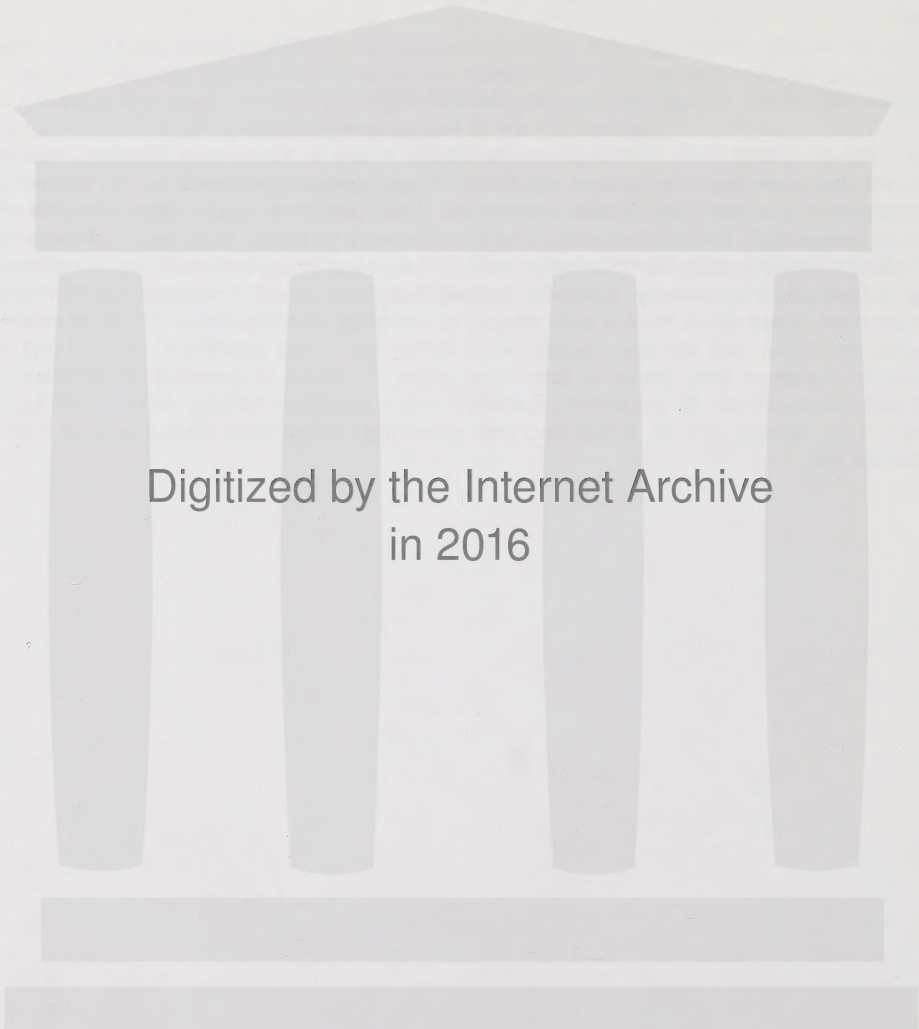
ABSTRACT

During a 1980–84 grizzly bear (*Ursus arctos horribilis*) study in Kananaskis Country, Alberta, 25 bears were snared and immobilized a total of 46 times. They were drugged with a 1:1 mixture of ketamine hydrochloride and xylazine hydrochloride injected by Cap-Chur darts. Mean initial dosages of each drug injected into successfully immobilized males and females were 10.6 and 10.3 mg/kg, respectively. Dosages from 5.3 to 14.0 mg/kg induced immobilization, but about 11 mg/kg is recommended to maintain tractability for about 1 hour. As indicated by a nursing female that received 23.1 mg/kg over 30 minutes with no apparent problem, these drugs have a wide margin of safety for grizzlies. Induction times averaged 9.3 and 7.0 minutes for males and females, respectively. Within the range examined, dosage had no apparent relationship to induction time, heart or respiration rates, or rectal temperature of grizzlies. Bears were weighed and measured on 45 occasions. Subadult males averaged 138 kg, females 90 kg; adult males averaged 177 kg, females 111 kg. Males also had consistently larger body measurements than did females of comparable age.



1.0 INTRODUCTION

Between 1980 and 1984, the Alberta Fish and Wildlife Division conducted a major investigation of grizzly bears in Kananaskis Country, Alberta (Carr 1989). The general goal was to obtain demographic and distributional information to assist in conservation of grizzlies in that rapidly developing outdoor recreation area about 50 km southwest of Calgary. For that investigation, it was necessary to capture, mark, and release as many study-area bears as possible.

Because of their relative availability, cost, and safety and the absence of legal restrictions, a mixture of the drugs ketamine hydrochloride and xylazine hydrochloride was used to immobilize the bears for processing. Although these drugs had been used with considerable success for immobilizing black bears (*Ursus americanus*) (Addison and Kolenosky 1979) and polar bears (*Ursus maritimus*) (Lee et al. 1981), Alberta Fish and Wildlife Division had little experience with the use of these drugs on grizzlies (Hebert and McFetridge 1979; Lynch et al. 1982). However, 25 grizzlies were immobilized a total of 46 times during the study. The bears were also weighed and measured while immobilized.

Fieldwork was initiated by Alberta Fish and Wildlife staff in May 1980, but the bear trapping and handling aspects were contracted to Rocky Mountain Wildlife Research on 1 September 1980. From 1980 through 1983, that consulting firm, with direction and some assistance from Alberta Fish and Wildlife, provided all bear trapping and handling services. In addition, two grizzlies were processed by a graduate student in 1984.

The purpose of this manuscript is to report and analyze the drugging and morphometric data collected. These data were opportunistically collected under rugged field conditions, not under controlled experimental conditions. The specific objectives of this report are to evaluate the performance of the ketamine-xylazine mixture for immobilization of grizzlies, and to categorize, evaluate, and summarize the morphometric information collected from Kananaskis Country grizzlies.

2.0 PROCEDURES

2.1 Immobilization

Using Cap-Chur equipment (Palmer Chemical Co., Douglasville, Ga.), the field crew immobilized snared bears with a 1:1 mixture of ketamine hydrochloride and xylazine hydrochloride (KH-XH) concentrated to 200 mg each/ml of liquid (Haigh 1978; Lynch et al. 1982). In 1980, the crew attempted to deliver, intramuscularly, a dosage of 6.5 mg of each drug/kg of the bear's estimated weight. In subsequent years, the intended dosage was raised to 9.9 mg/kg. In this report, all dosages indicate the number of mg of each drug. If after 15 minutes the animal showed little or no response to the drugs, a second injection was administered. A bear was considered to be immobilized when there was no noticeable leg or head movement, even when touched. The amount of drug and times of injection and immobilization were recorded.

Once a bear appeared to be completely immobilized, the dart was first jiggled to verify discharge, then removed and opened to determine the amount of drug injected. The bear was weighed (to nearest kilogram) by raising it with a block and tackle attached to a dial scale suspended from a tree or tripod. If the bear had been substantially under-drugged for its weight, additional drugs were injected as necessary by hand syringe.

The dart wound was treated with antiseptic and the bear's eyes were protected with ophthalmic salve. The snare cable was transferred to another leg to keep the bear secured while enabling any necessary treatment of the originally snared leg. Heart and respiration rates, rectal temperature, and the times of measurement were recorded to evaluate the bear's reaction to the drugs. The snare was removed after processing was completed and personnel were ready to leave.

2.2 Morphometrics

In addition to weight, several body size measurements were recorded. Width of the zygomatic arch and length and width of the large pad on each of a front and hind foot were measured in millimetres with calipers. The remaining measurements were taken in centimetres with a steel tape: total length — distance from tip of nose to tip of tail with the tape following the curvature of the head and spine; chest girth — circumference just posterior to the edge of the scapula; shoulder height — distance from the top of the scapula to the base of the longest claw; neck girth — circumference midway between the occiput and the base of neck; and head girth — circumference at the widest point of the zygomatic arches.

2.3 Statistical Analysis

For all statistical evaluations, differences were considered significant based on $\alpha = 0.05$. Means were deemed to be different and the null hypothesis (Ho) was rejected if zero was excluded by a 95% confidence interval (CI) surrounding their difference. Variance equality was evaluated by the F–test, and CI's were constructed from the t-distribution using appropriate formulae (Bailey 1959:50-51). Observed probabilities leading to rejection or acceptance of Ho, when provided, were determined by interpolation from statistical tables in Zar (1984).

3.0 RESULTS AND DISCUSSION

3.1 Immobilization

Appendices 1 and 2 list the immobilization data for all female and male grizzly bears, respectively.

3.1.1 Dosage

In 1980, which was the first year of trapping, the intended KH-XH dosage rate was about 6.5 mg of each drug/kg of body weight, the same dosage we were using successfully on black bears and similar to that used by Lee et al. (1981) on polar bears. Of the 6 captures handled with this intended dosage, only 3 could be considered satisfactory, and 2 of these involved actual dosages exceeding the intended 6.5 mg/kg. The weight of bear H2 was overestimated by 53%, and he therefore received a more appropriate dosage of 9.6 mg/kg. H5 weighed 185 kg on 5 September 1980, and when recaptured on 26 October, he was given 9 cc of drug. This time he was not weighed, but a dosage of 8.8 mg/kg was based on an estimate of 205 kg. H1 received only 6.3 mg/kg; he was immobilized after 9 minutes and was processed without incident, although the field card notes "some resistance" 87 minutes after injection.

The remaining 3 immobilizations in 1980 were less satisfactory. H3, H4, and H5 all required additional injections to achieve immobilization; H4 still recovered prematurely, charged the crew, and had to be shot. Details of these immobilizations, along with 4 others deemed unsatisfactory, are discussed later in this report.

After evaluation of initial results, the intended dosage of the KH-XH combination was increased to 9.9 mg of each drug/kg of body weight. Subsequent variation in the administered dosages resulted mainly from errors in estimating bear weights prior to darting.

Actual initial dosages were calculated for 11 female and 26 male captures in which immobilization was achieved with the initial injection. The average dosages for female cubs, subadults, and adults were 9.7, 12.2, and 9.9 mg/kg, respectively (Table 1). Male subadults received an average of 11.0 mg/kg, adults 10.0 mg/kg (Table 2). The overall mean initial dosages received by females and males were 10.3 and 10.6 mg/kg, respectively.

Overall, successful immobilization was achieved with initial dosages ranging from 5.3 (K1) to 14.0 (H6) mg/kg. However, of 7 successful immobilizations with dosages below 9 mg/kg, 4 (57%) required supplemental injections to maintain immobilization throughout the processing. Of 30 successful immobilizations with initial injections greater than 9 mg/kg, only 6 (20%) required supplemental injections to maintain immobilization. As shown in Table 3, the ability to sustain immobilization improved with increasing dosage; however, even with the higher initial dosages, supplemental injections were sometimes needed.

For complete immobilization and tractability for about 1 hour, these data indicate that an appropriate dosage rate is about 11 mg of each drug/kg of grizzly. Of 15 bears initially receiving 11 mg/kg or more, only 2 required supplemental injections. As shown in Tables 1 and 2, the total dosage received (initial plus supplemental injections) by females and males averaged 11.1 and 11.0 mg/kg. Dosages greater than 11 mg/kg did not seem to offer much additional advantage but probably delayed recovery. Ramsay et al. (1985) report mean KH-XH dosages of 12.9 and 11.3 mg/kg (each drug) for immobilizing polar bears in 1983 and 1984, respectively.

Much can be learned from the unsatisfactory immobilizations. Seven were deemed unsatisfactory or abnormal; they are discussed below and detailed in Tables 4 and 5. Actual effective dosages are not precisely known, especially relative to time, usually because of dart or darting failure. Three unsatisfactory immobilizations (of H3, H4, and H5) were handled in 1980; as discussed in part previously, the problems were related to the low intended dosages ($\pm$6.5 mg/kg) and were exacerbated, in the cases of H4 and H5, by darting failures.

Although H3 was darted squarely on his hindquarter, the injection (8 mg/kg) was ineffective,

Table 1. Dosages and induction times for female grizzly bears immobilized by initial injections of a 1:1 mixture of ketamine and xylazine hydrochlorides.

Age-class	Bear	Date	Wt (kg)	Induction (min)	Dosage (mg each drug/kg)		
					Initial	Additional[a]	Total
Cubs[b]	H11	13 Aug 82	88	7	11.4		11.4
	H12	11 Jul 82	94	5	8.5	2.1	10.6
	H12	26 Jul 82	87	7	9.2	2.3	11.5
	Mean			6.3	9.7		11.2
Subadults[c]	H11	6 Jun 83	88	9	13.6		13.6
	H11	18 Jun 83	91	6	10.8		10.8
	Mean			7.5	12.2		12.2
Adults	H8	19 Aug 81	109	6	9.2		9.2
	H9	1 Jul 82	106	6	12.3		12.3
	H9	12 Jul 82	106	8	8.5		8.5
	H9	26 Jul 82	108	5	11.1		11.1
	H13	15 Jul 82	124	9	6.4	3.2	9.6
	H20	24 Jul 83	104	9	11.9	1.9	13.8
	Mean			7.2	9.9		10.8
	SD			1.72	2.28		2.03
	95% CL:			5.4	7.5		8.7
	:			9.0	12.3		12.9
Overall Mean				7.0	10.3		11.1
SD				1.55	2.09		1.68
95% CL:				6.0	8.9		10.0
:				8.0	11.7		12.2

[a]Additional drug administered during processing to ensure continued immobilization.

[b]The cub group involved cubs-of-the-year, yearlings, and 2-year-olds, but all 3 immobilizations involved only 2-year-olds.

[c]The subadult group included 3-, 4-, and 5-year-olds, but both immobilizations involved only 3-year-olds.

Table 2. Dosages and induction times for male grizzly bears immobilized by initial injections of a 1:1 mixture of ketamine and xylazine hydrochlorides.

Age-class	Bear	Date	Wt (kg)	Induction (min)	Dosage (mg each drug/kg)		
					Initial	Additional[a]	Total
Subadults[b]	H2	14 Aug 80	104	9	9.6		9.6
	H6	3 Jul 81	129	12	14.0		14.0
	H10	26 Jun 82	178	8	9.6		9.6
	H14	5 Aug 82	124	7	9.7		9.7
	H14	12 Aug 82	126	5	10.3		10.3
	H16	4 Jun 83	148	7	12.2		12.2
	H16	12 Jun 83	127	6	12.6		12.6
	H16	20 Jun 83	126	11	11.1		11.1
	H16	12 Aug 83	130	6	8.0		8.0
	H18	30 Jun 83	131	9	10.4		10.4
	H21	24 Jul 83	145	10	9.6		9.6
	H21	5 Aug 83	144	9	10.4		10.4
	S1	17 Jun 81	125	7	13.6		13.6
	S1	26 Jul 82	156	12	10.9	1.3	12.2
	S2	30 May 83	130	12	10.5	3.1	13.6
	S3	15 Jun 83	124	19	12.7		12.7
	Mean			9.3	11.0		11.2
	SD			3.44	1.65		1.79
	95% CL:			7.5	10.1		10.2
	:			11.1	11.9		12.2

Table 2. (Continued).

Age-class	Bear	Date	Wt (kg)	Induction (min)	Dosage (mg each drug/kg)		
					Initial	Additional[a]	Total
Adults	H1	13 Aug 80	153	9	6.3		6.3
	H1	26 Jul 82	175	9	10.3		10.3
	H1	12 Jun 84	170	8	10.6		10.6
	H7	9 Aug 81	186	5	12.2		12.2
	H7	26 Sep 81	214	14	11.6		11.6
	H14	20 Jul 83	137	18	11.7		11.7
	H15	26 May 83	178	13	13.5	1.7	15.2
	H19	22 Jul 83	164	6	8.3	1.2	9.5
	H19	24 Aug 83	173	6	9.9	1.2	11.1
	K1	27 Jun 82	195	5	5.3	2.8	8.1
	Mean			9.3	10.0		10.7
	SD			4.37	2.62		2.41
	95% CL:			6.2	8.1		9.0
	:			12.4	11.9		12.4
Overall Mean				9.3	10.6		11.0
SD				3.74	2.08		2.02
95% CL:				7.8	9.8		10.2
:				10.8	11.4		11.8

[a]Additional drug administered during processing to ensure continued immobilization.

[b]The subadult group included 3-, 4-, and 5-year-olds.

perhaps because it was into fatty tissue which would have slowed its absorption. H3 was in excellent condition. Supplemental injections were delayed unnecessarily by a cautious and still inexperienced crew, but thereafter such injections were administered in about 15 minutes if the bear showed little reaction to the drugs.

A second dart carrying the second half of the initially intended dosage for H4 bounced off the bear; the amount of drug injected, if any, was unknown. Thus, a third dart was not delivered until 20 minutes after the first. Because its weight was overestimated, the bear received at least 10 mg/kg — but over a 20-minute time span. Immobilization occurred at 34 minutes, but because of the delayed induction, the crew was still present at 95 minutes when the bear recovered and charged. Because of their unfamiliarity at the time with the reactions and characteristics of bears immobilized by KH-XH, the crew did not respond with appropriate dispatch — either to inject additional drug or to clear the area — when the bear had raised its head 5 minutes earlier. Movement of the head or large muscles by grizzlies drugged with KH-XH appears indicative of

Table 3. The relationship between successful initial dosage rates with a 1:1 mixture of ketamine and xylazine hydrochlorides and the need for supplemental injections to maintain immobilization of grizzly bears throughout a processing period of about 1 hour.

Immobilizations[a]	Initial dosage rate (mg each drug/kg)					Total
	<9	9-9.99	10-10.99	11-11.99	≥12	
N requiring initial injection only	3	5	6	6	7	27
N requiring supplemental injections [b]	4	2	2	1	1	10
Total	7	7	8	7	8	37
% requiring supplemental injections [b]	57	29	25	14	12	27

[a]All immobilizations were successfully induced with the initial injection.

[b]Supplemental injections were given only if needed to maintain immobilization previously achieved with the initial injection.

imminent recovery, which handlers must heed immediately.

Although the crew was unaware of the problem, the first dart carrying 6cc of KH-XH failed to discharge fully into H5, which, consequently, received only about 5.4 mg/kg of each drug. A second dart delivered an additional 3.2 mg/kg at 15 minutes, immobilizing H5 1 minute later at 16 minutes. No further problem occurred, even though H5 received only 8.6 mg/kg in total over a 15-minute time span.

Three other unsatisfactory immobilizations (H11, H17, and H10) were related to inadequate dosage in spite of the increase in the intended rate to 9.9 mg/kg. With H11, the first dart failed to discharge. She was immobilized at 41 minutes with only half the intended dosage, all delivered by a second dart at 33 minutes. When the failure of the first dart was detected, the remainder of the dosage was injected and the bear processed with no further problem. This example attests to the importance of verifying the actual injection when first approaching drugged animals that are as potentially dangerous as grizzlies.

The problem with H17 was similar in that the first dart failed to discharge fully. Despite this failure, induction occurred at 22 minutes. The drugs remaining in the first dart, along with an additional 2 cc, were injected at 24 minutes. H17 was given a total of 11.9 mg/kg over 24 minutes and was processed successfully.

The intended dosage for H10 was given in 2 darts, delivered 10 minutes apart because of handling difficulties. In spite of receiving 10.6 mg/kg from the 2 darts combined, the bear did not go down. A third injection of 1.9 mg/kg at 35 minutes exhausted the drug supply without immobilizing the bear. The crew returned about 5 hours later and successfully immobilized H10 with 5.8 mg/kg followed by an additional 4.8 mg/kg (total 10.6 mg/kg) 15 minutes later. In this case, the delay was due to uncertainty about residual effects from the earlier drugging attempts; however, from this and the H4 experiences, it appears that the entire intended dosage of these drugs should be injected at the same time to ensure its effectiveness. Delivering the drugs over a span of even 10 minutes seems either to reduce the drugs' impact or increase the bear's resistance to their effects.

In contrast to the foregoing, the last abnormal immobilization was the excessive dosage of H9, a 14-year-old female nursing cubs. Estimated to weigh 181 kg, this 109 kg female became immobilized 20 minutes after receiving an initial dosage of 16.5 mg/kg. In spite of this excessive dosage, the bear raised her head 5 minutes later and, consequently, was given an additional 6.6 mg/kg at 30 minutes. The total dosage of 23.1 mg/kg was the greatest received by any bear in this study, and it suggests that bear tolerance to KH-XH is good.

Although H9's total down-time was not recorded, the bear's slow induction time combined with her early movement suggested that, for some reason,

Table 4. Details of unsatisfactory immobilizations of female grizzly bears with a 1:1 mixture of ketamine and xylazine hydrochlorides.

Bear	Date	Wt (kg)	Drug		Time (min)		Problem description
			Amt (cc)	Dosage (mg each drug/kg)	Since initial injection	Of immobilization	
H4	29 Aug 80	121	3.0	5.0	0		half attempted dosage
			3.0	5.0	5		dart bounced off; amount injected unknown
			3.0	5.0	20	34	bear received at least 10 mg/kg
					90		head lifted; additional drug should have been given
					95		bear charged and was shot
H9	13 Sep 81	109	9.0	16.5	0	20	overestimated weight; dosage excessive
			3.6	6.6	30		bear raised head, so given additional 3.6 cc for a total of 23.1 mg/kg
H11	8 Jul 82	93	4.0	8.6	0		dart did not discharge; amount injected unknown
			2.0	4.3	33(0)	41(8)	additional 4.3 mg/kg delivered
			2.0	4.3	45(12)		total injection at least 8.6 mg/kg

the injection was ineffective. She did not appear to be unusually resistant to these drugs, since she was immobilized 3 times the next year with more normal dosages and induction times of 5, 6, and 8 minutes. Addison and Kolenosky (1979) found lactating black bears required longer induction times than did other females. In addition, Schweinsburg et al. (1982) suggested an apparent ability of polar bears to resist KH-XH anesthesia in some instances. Using KH without XH on black bears, Hugie et al. (1976) noted that induction was more difficult and downtime shorter when "hyper-excitable" individuals were immobilized.

3.1.2 Induction

Induction times could be determined for 11 female and 26 male immobilizations (Tables 1 and 2). These involved bears in which induction was achieved as a result of the initial injection, although in some cases the drugs were delivered in 2 darts.

Induction times differed for males and females ($P = 0.012$) and averaged 2.3 ± 1.8 minutes (95% CI) longer for males. Extraneous influences were not controlled, but the difference in mean dosage received by males and females (0.3 ± 1.52 mg/kg [95% CI], $P = 0.69$) was small and should not have affected these results. This sex difference in grizzly induction times contrasts with black bear and polar bear induction data (Addison and Kolenosky 1979; Lee et al. 1981, respectively), which show no significant difference between males and females.

Within each sex-class, induction times for different age groups are similar; however, data are limited as

Table 5. Details of unsatisfactory immobilizations of male grizzly bears with a 1:1 mixture of ketamine and xylazine hydrochlorides.

Bear	Date	Wt (kg)	Drug		Time (min)		Problem description
			Amt (cc)	Dosage (mg each drug/kg)	Since initial injection	Of immobil-ization	
H3	28 Aug 80	166	6.6	8.0	0		ineffective injection, perhaps into fat
			2.0	2.4	46		still only 10.4 mg/kg
			2.0	2.4	68	76	
					181		moved legs and head
					213		bear sat up
					215		bear charged
H5	5 Sep 80	185	5.0	5.4	0		dart failed; ±5 cc drug delivered
			3.0	3.2	15	16	still only 8.6 mg/kg
					246		bear got up then lay down again
H10	7 Oct 82	207	6.0	5.8	0		inadequate dosage
			5.0	4.8	10		bear still not immobile
			2.0	1.9	35		ran out of drug
			6.0	5.8	275(0)		tried again 5 hours later
			5.0	4.8	290(15)	300(25)	
H17	13 Jun 83	203	8.0	7.9	0		dart failure, not all 8 cc delivered
			2.0	2.0	2	22	
			2.0	2.0	24		remaining drug from first injection plus additional 2 cc
					190		front paw movement
					193		head movement
					233		head up
					234		walked away unsteadily

only 3 cub (both 2-year-olds) and 2 subadult female immobilizations were done. No male cubs were immobilized. Lee et al. (1981) found significant differences in both effective dosages and induction times between cubs-of-the-year and older polar bears. Also, Addison and Kolenosky (1979) found induction times were shorter for black bears under 25 kg. In our study, however, no grizzlies under 2 years old were immobilized for comparison. Within our range of dosages, there was no apparent positive or negative relationship between dosage and induction time. Similarly, Addison and Kolenosky (1979) found no significant difference in induction times for black bears receiving high or low dosages.

3.1.3 Physiological Parameters

Rectal temperatures and heart and respiration rates were recorded to monitor the condition of immobilized bears. Although heart rates, respiration rates, and temperatures varied widely, there was little difference in averages between sexes (Table 6). The figures in Table 6 indicate ranges to be expected for similar situations, and they are similar to figures listed by Addison and Kolenosky (1979) for black bears and Lee et al. (1981) for polar bears. An elevated respiration rate of 61 for a subadult male (S2) indicated some extraordinary duress and was excluded from the table. In addition, although S2's heart rate was somewhat depressed (39 beats/minute) and his temperature slightly elevated (39.4C), he recovered satisfactorily.

Because these parameters differed little between males and females, the sexes were combined for age-class evaluations (Table 7). The means between age-classes are similar except for cub heart rates, which may be somewhat higher. They averaged 73 beats/minute compared to 61 and 55 for subadults and adults, respectively. However, cubs were monitored only 4 times.

The relationships of drug dosage to rectal temperature and rates of heartbeat and respiration were examined (Table 8). These figures were from immobilizations induced and completed with a single injection. The parameters were measured during the approximately 1-hour processing period, but they might have been influenced by specific times of measurement, which varied relative to initial injection. Based on scattergramming of the observations listed in Table 8, there were no obvious positive or negative relationships between these parameters and the range of dosages injected.

3.2 Morphometrics

Body weights and measurements were recorded for 45 of the 46 captures and are listed in Appendices 3 and 4. No measurements were recorded for 1 female captured in June 1984, and individual measurements were sometimes missed, usually because of equipment failure, darkness, or early recovery from immobilization.

3.2.1 Weight

As found by other researchers (Pearson 1975; Russell et al. 1979; Miller et al. 1982; Nagy et al. 1983*a*, *b*), males were heavier than females of the same age (Table 9). Although samples were small and variable, weights of male and female adults differed ($P < 0.001$) by an average of 65.9 ± 13.3 kg (95%CI). Subadult males averaged 138 kg, females 90 kg. Adult males averaged 177 kg, females 111 kg. Male adults were heavier than male subadults ($P < 0.001$). Too few females were weighed for adequate comparison between female adults and subadults. Comparison of weights for bears from the Kananaskis population with those of bears from other populations is difficult because of small samples and variability from various sources, especially bear age and measurement date. However, Kananaskis bears appear generally heavier than those weighed by Pearson (1975) in the southern Yukon (adult males averaged 139 kg, females 95 kg) but lighter than those weighed by Russell et al. (1979) in Jasper National Park (adult males averaged 221 kg, females 134 kg).

Samples were too small and too influenced by extraneous factors to provide reliable weight estimates for individual year-classes. However, data from Table 9 imply that these grizzlies approached full growth by age 6, suggesting that subsequent weight changes were related mainly to seasonal fat deposition and depletion. Growth has greater influence on weight changes in younger age-classes than in older ones. Weight, which reflects both growth and fat accumulation is, therefore, influenced by date of measurement.

Male bear weights fluctuated seasonally (Table 10), generally decreasing through spring (May–June) when quality foods were scarce. After declining to lowest weights in summer (July–August), these males regained weight most rapidly in late summer and fall, likely in response to abundant berries and other fall foods. Although highly variable, this

Table 6. Mean heart rate, respiration rate, and temperature for male and female grizzly bears immobilized with a 1:1 mixture of ketamine and xylazine hydrochlorides.

Sex	Heart (beats/min)				Respiration (breaths/min)				Temperature (C)			
	N	Mean	SE	Range	*N*	Mean	SE	Range	*N*	Mean	SE	Range
M	30	60	5.5	33-84	29	11	0.7	5-20	28	38.8	0.12	37.7-40.2
F	13	59	4.2	35-84	14	9	0.8	4-13	14	38.7	0.24	36.9-40.6

Table 7. Mean heart rate, respiration rate, and temperature by age-class for grizzly bears immobilized with a 1:1 mixture of ketamine and xylazine hydrochlorides.

Age-class	Heart (beats/min)				Respiration (breaths/min)				Temperature (C)			
	N	Mean	SE	Range	*N*	Mean	SE	Range	*N*	Mean	SE	Range
Cub (0-3 years)	4[a]	73	4.5	62-84	4[a]	12	0.2	12-13	4[a]	39.2	0.28	38.6-39.1
Subadult (3-6 years)	19	61	2.5	39-84	18	10	0.9	4-20	18	38.8	0.20	36.9-40.2
Adult (6 + years)	20	55	3.2	33-84	21	10	0.8	5-20	20	38.7	0.15	37.7-40.6

[a]Cubs immobilized were 2-year-old females.

pattern of weight fluctuation, particularly the rapid gain in late summer, also seemed to occur in grizzly populations studied elsewhere (Pearson 1975; Nagy and Russell 1978; Craighead and Mitchell 1982). In this study, however, the trend is not conspicuous, likely because the data are so influenced by variability in year and date of measurement and actual age of the bears. Sample sizes are too small to permit stratification of these effects. Inadequate numbers of females were weighed in each season to identify similar trends.

A few bears that were weighed more than once provide additional insight into the pattern of weight change. A subadult male (H10) increased 29 kg (0.28 kg/day) between 26 June and 7 October 1982. An adult male (H7) gained 28 kg (0.58 kg/day) between 9 August and 26 September 1981, the higher rate perhaps related to berry availability in later summer. A more complete picture was shown by H16, a 3-year-old subadult male that weighed 148 kg on 4 June 1983. On 12 June, 8 days later, he weighed 127 kg, a loss of 2.62 kg/day during this late spring period. He was 1 kg lighter on 20 June, but by 12 August 1983, he had increased to 130 kg. The extreme loss between 4 and 12 June was likely abnormal and related to individual circumstances, as 3-year-old female H11, confounding the general pattern, gained 3 kg over essentially the same period (6 to 18 June).

3.2.2 Body Measurements

Various body measurements recorded during the trapping program are summarized by age-class for male and female grizzlies (Tables 11 and 12, respectively). However, only 2 subadult females (both 3-year-olds) and no male cubs were

Table 8. Induction times, rectal temperatures, and heart and respiration rates of grizzly bears listed in order of increasing dosage with a 1:1 mixture of ketamine and xylazine hydrochlorides.

Sex	Age-class	Dosage (mg each drug/kg)	Induction (min)	Heart (/min)	Resp (/min)	Temp (C)
Male	Subadults	8.0	6	65	10	39.2
		9.6	8	64	16	40.2
		9.6	9	62	8	38.6
		9.6	10	48	10	39.1
		9.7	7	68	9	38.7
		10.3	5	70	11	38.7
		10.4	9	64	7	40.2
		10.4	9	56	10	39.7
		11.1	11	66	8	38.2
		12.2	7	84	7	38.3
		12.6	6	60	5	37.8
		12.7	19	78	12	38.4
		13.6	7	58	18	
		14.0	12	45	9	38.7
	Adults	6.3	9	46	7	37.9
		10.3	9	68	12	38.3
		10.6	8	48	12	37.9
		11.6	14	52	8	
		11.7	15	80	7	38.8
		12.2	5	33	9	39.1
Female	Subadults	10.8	6	60	4	37.7
		13.6	9	72	7	36.9
	Adults	8.5	8		6	37.9
		9.2	5	43	7	39.8
		11.1	5	58	12	38.6
		12.3	6	54	12	38.5

Table 9. Relationship of age (years) to mean weights (kg) of grizzly bears trapped and weighed in Kananaskis Country, Alberta.

Age	Male				Female			
	N	Mean wt	± 95% CL	Range	*N*	Mean wt	± 95% CL	Range
2					4	90		87-94
Cubs					4	90	5.6	
3	9	144		126-207	2	90		88-91
4	2	114		104-125	0			
5	6	137		124-156	0			
Subadults	17	138	12.4		2	90	18.9	
6	2	170		137-203	3	118		109-124
7	2	168		164-173	0			
8	1	195			0			
9	1	166			0			
10	0				1	104		
11	0				0			
12	1	153			0			
13	0				0			
14	2	180		175-185	1	109		
15	3	193		178-214	1	107		
16	1	170			0			
Adults	13	177	12.4		8	111	6.2	

measured, so only adults provide data for comparing sexes. For all measurements of adults, males are larger than females, and all differences are significant ($P < 0.05$). Also, subadult males are generally slightly larger than adult females, and, except for zygomatic width ($P = 0.181$), all mean measurements are different ($P < 0.05$).

For all parameters, adults have larger measurements than do subadults of the same sex (Tables 11 and 12). For males, the differences are significant ($P < 0.05$) except for front pad length ($P = 0.099$). For females, mean measurements are all larger for adults than for subadults. However, the differences among all female age groups remain unclear because of small samples and large variances. The 6 sets of measurements of female cubs and subadults actually involve only 2 bears, each measured twice as 2-year-old cubs and once the following June as 3-year-old subadults.

Table 10. The influence of time of year on weight (kg) of grizzly bears trapped and weighed in Kananaskis Country, Alberta.

Sex	Age-class	May–June				July–August				September–October		
		N	Mean wt	SE	Range	*N*	Mean wt	SE	Range	*N*	Mean wt	Range
Male	Subadults	8	136	6.6	124-178	8	132	5.6	104-156	1	207	
	Adults	4	186	7.6	170-203	7	165	6.0	137-186	2	200	185-214
Female	Cubs					4	90	1.8	87-94			
	Subadults	2	90		88-91							
	Adults					7	111	3.0	104-124	1	109	

Table 11. The size of male grizzlies trapped in Kananaskis Country, Alberta, as indicated by the means of various body measurements.[a]

Parameter	Subadults (3–5 years)			Adults (6 + years)		
	N	Mean	± 95% CL	*N*	Mean	± 95% CL
Weight (kg)	17	138	12.4	13	177	12.4
Circumference of						
Head (cm)	16	65.7	1.5	12	72.4	2.2
Neck (cm)	16	65.1	1.8	13	73.8	2.9
Chest (cm)	16	106.6	4.0	13	120.5	4.6
Zygomatic width (cm)	16	19.4	0.5	13	23.2	1.1
Shoulder height (cm)	16	96.3	3.2	12	102.7	3.9
Total length (cm)	15	184.5	6.0	13	197.8	8.9
Pad width						
Front (mm)	16	131.6	3.7	13	139.9	3.9
Hind (mm)	16	123.6	3.2	13	130.9	4.8
Pad length						
Front (mm)	16	74.9	4.6	13	80.2	4.7
Hind (mm)	16	173.7	4.7	13	180.5	4.9

[a]Based on individual measurements listed in Appendix 3.

Table 12. The size of female grizzlies trapped in Kananaskis Country, Alberta, as indicated by the means of various body measurements.[a]

Parameter	Cubs (2 years)[b]		Subadults (3 years)[b]		Adults (6 + years)	
	Mean ($N = 4$)	± 95% CL	Mean ($N = 2$)	± 95% CL	Mean ($N = 8$)	± 95% CL
Weight (kg)	90	5.6	90	18.9	111	6.2
Circumference of						
Head (cm)	53.3	3.0	59.0	0.0	61.5	2.1
Neck (cm)	53.0	4.4	54.0	12.6	60.4	3.9
Chest (cm)	86.5	3.8	93.0	37.8	98.8	3.7
Zygomatic width (cm)	17.1	0.5	17.3	3.8	19.0	0.3
Shoulder height (cm)	80.5	6.7	78.0	101.6	86.6	5.8
Total length (cm)	159.0	8.6	165.0	25.2	173.0	5.8
Pad width						
Front (mm)	111.0	11.3	115.5	31.5	118.3	3.0
Hind (mm)	107.8	3.0	105.5	44.0	112.5	2.7
Pad length						
Front (mm)	56.5	10.8	56.5	70.1	69.5	6.2
Hind (mm)	143.8	6.0	146.5	44.9	155.8	4.8

[a]Based on individual measurements listed in Appendix 4.

[b]Data for cubs and subadults are from only 2 females, each measured twice at 2 years of age and once at 3.

Tables 13 and 14 show average measurements for each of 6 parameters for individual year-classes of male and female bears, respectively. Unfortunately, all year-class averages other than 2-year-old females and 3- and 5-year-old males are based on samples of 3 or fewer bears. Several are represented by measurements from only 1 bear.

These measurements suggest that grizzlies attain most of their body growth by 6 years of age. Most year-class samples are too small to provide reliable average sizes, but there is some suggestion that males continue to grow slowly beyond 6 years of age. In contrast, females show little evidence of growth after 6 years, perhaps the time when they begin diverting more resources to reproduction and care of young. Miller et al. (1982) suggested a similar diversion of resources. More detailed evaluations of grizzly bear size, weight, and growth patterns have been provided by Troyer and Hensel (1969), Glenn (1980), Kingsley et al. (1983), and Kingsley et al. (1988).

Some parameters, by their nature, can be measured more consistently than others. Zygomatic width, and girth of the chest, neck, and head can be measured easily with good precision. Zygomatic width is not greatly influenced by fat deposition. It has a curvilinear relationship with grizzly age, and that relationship has been studied in detail by several authors (Mundy and Fuller 1964; Pearson 1975; Nagy et al. 1983*a*, *b*). Chest girth is influenced greatly by fat deposition and, therefore, is related more directly to weight than to age as has been shown by Miller et al. (1982) and Nagy et al. (1984). Head and neck girth also produce

Table 13. The relationship of various body measurements (cm) to age (years) of male grizzlies trapped in Kananaskis Country, Alberta.

		Circumference of											
		Head		Neck		Chest		Zygomatic width		Shoulder height		Total length	
Age	N	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
3	8[a]	66.1	1.1	64.9	1.0	109.0	2.8	19.3	0.4	97.9	2.4	187.4	2.2
4	2	64.0	0.0	62.5	2.5	102.5	5.5	18.8	0.1	89.0	6.0	180.0	5.0
5	6	65.6	1.2	66.2	1.6	104.6	2.9	19.8	0.3	96.5	1.1	182.5	6.5
6	2	71.5	4.5	73.5	9.5	117.0	8.0	21.8	1.6	104.5	10.5	184.0	18.0
7	2	74.0	1.0	73.0	1.0	113.0	0.0	21.4	0.2	100.5	0.5	209.0	1.0
8	1	75.0		72.0		123.0		23.5		99.0		203.0	
9	1	65.0		69.0		117.0		21.0		103.0		195.0	
10	0												
11	0												
12	1	76.0		73.0		114.0		24.8		93.0		203.0	
13	0												
14	3[b]	72.0	1.2	75.0	2.5	128.0	4.5	24.4	0.6	105.5		197.6	12.5
15	2[c]	73.0		77.0	1.0	126.5	1.5	25.0	0.0	105.5	3.5	201.5	11.5
16	1	73.0		74.0		116.0		22.0		105.0		189.0	

[a]For total length, 3-year-olds, $N = 7$.

[b]For shoulder height, 14-year-olds, $N = 1$.

[c]For head circumference, 15-year-olds, $N = 1$.

reasonably consistent results. Conversely, both shoulder height and total length are difficult to measure precisely or consistently. Foot pad measurements seem particularly variable and poorly related to age. The fleshy nature of the pads makes precise measurement difficult. It also seems that bear pads are individually quite variable in length and width.

Although body measurements obviously have some relationship to age, their variability is great. For males in most cases, weight, shoulder height, total length, zygomatic width, and neck, head, and chest circumference will separate adults from subadults. These data are too sparse to indicate if similar separation would be possible for females. Assignment of specific age to any bear on the basis of body measurements from this study alone would be questionable.

Table 14. The relationship of various body measurements (cm) to age (years) of female grizzlies trapped in Kananaskis Country, Alberta.

		Circumference of											
		Head		Neck		Chest		Zygomatic width		Shoulder height		Total length	
Age	*N*	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
2	4	53.1	1.0	53.0	1.4	86.5	1.2	17.1	0.2	80.5	2.1	159.0	2.7
3	2	59.0	0.0	54.0	1.0	93.0	3.0	17.3	0.3	78.0	8.0	165.0	2.0
4	0												
5	0												
6	3	60.0	1.0	59.0	3.2	99.3	3.2	19.0	0.3	93.0	3.8	176.3	2.4
7	0												
8	0												
9	0												
10	1	62.0		57.0		96.0		18.9		88.0		182.0	
11	0												
12	0												
13	0												
14	1	61.0		59.0		106.0		18.7		85.0		161.0	
15	3	63.0	2.0	60.0	0.0	96.6	0.3	19.2	0.1	80.3	0.3	170.6	2.3

4.0 CONCLUSIONS

Conclusions for the study are as follows:

1. The ability to sustain immobilization of grizzlies improves with increasing dosage of KH-XH. For immobilization and tractability of about 1 hour, a rate of about 11 mg/kg is recommended.

2. A wide margin of safety is apparent in the use of KH-XH on grizzlies.

3. For grizzlies 2 years and older given KH-XH, mean induction time is about 7.0 minutes for females and 9.3 minutes (33% longer) for males.

4. Within the range examined, KH-XH dosage has no apparent relationship to induction time, heart or respiration rates, or rectal temperature of grizzlies.

5. Grizzlies are sexually dimorphic with males consistently heavier and larger than females of similar age.

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APPENDIX

Appendix 1. Immobilization data for female grizzly bears drugged with ketamine and xylazine hydrochlorides (200 mg of each drug/cc) in Kananaskis Country, Alberta.

Age-class	Bear	Date	Wt (kg)	Drug Amt		Time (min)[a]			Heart[c]	Resp[c]	Temp[c]
				cc	mg/kg[b]	Ind	Add	Down			
Cubs	H11	8 Jul 82	93	2.0	4.30	8			62:32	12:30	39.8:31
				2.0	4.30		12				
	H11	13 Aug 82	88	5.0	11.36	7			84:24	13:20	38.8:27
	H12	11 Jul 82	94	4.0	8.51	5			72:23	12:24	39.4:33
				1.0	2.13						
	H12	26 Jul 82	87	4.0	9.19	7			75:15	12:30	38.6:34
				1.0	2.30						
Subadults	H11	6 Jun 83	88	6.0	13.63	9			72:30	7:32	36.9:34
	H11	18 Jun 83	91	4.9	10.76	6			60:23	4:19	37.7:24
	H11	12 Jun 84		5.5		12					
Adults	H4	2 Aug 80	121	3.0	4.96	34		61	42:	9:	39.0:68
				3.0	4.96		20				
	H8	19 Aug 81	109	5.0	9.17	6			43:23	7:24	39.8:39
	H9	13 Sep 81	109	9.0	16.51	20			35:45	7:63	38.8:54
				3.6	6.61		30				
	H9	1 Jul 82	106	6.5	12.26	6		300	54:42	12:42	38.5:37
	H9	12 Jul 82	106	4.5	8.49	8				6:26	37.9:33
	H9	26 Jul 82	108	6.0	11.11	5			58:17	12:20	38.6:22
	H13	15 Jul 82	124	4.0	6.45	9		222	69:28	7:28	38.0:38
				2.0	3.23		13				
				1.0	1.61						
	H20	24 Jul 83	104	6.2	11.92	9			44:36	13:39	40.6:39
				1.0	1.92		15				

[a]Ind: Induction time measured from initial injection until bear was immobilized. Add: Time of additional injections measured from initial injection. Down: Length of time bear remained immobilized.

[b]Dosage in mg of each drug/kg bear weight.

[c]Heart rate in beats/minute, respiration rate in breaths/minute, rectal temperature in C, and each followed by time of measurement in minutes since initial injection.

Appendix 2. Immobilization data for male grizzly bears drugged with ketamine and xylazine hydrochlorides (200 mg of each drug/cc) in Kananaskis Country, Alberta.

Age-class	Bear	Date	Wt (kg)	Drug Amt		Time (min)[a]			Heart[c]	Resp[c]	Temp[c]
				cc	mg/kg[b]	Ind	Add	Down			
Subadults	H2	14 Aug 80	104	5.0	9.61	9			62:	8:	38.6:28
	H6	3 Jul 81	129	9.0	13.95	12			45:45	9:55	38.7:60
	H10	26 Jun 82	178	8.5	9.55	8			64:49	16:42	40.2:41
	H10	7 Oct 82	207	6.0	5.79	25			52:52	12:55	38.9:60
				5.0	4.83		15				
	H14	5 Aug 82	124	6.0	9.67	9			68:29	9:32	38.7:35
	H14	12 Aug 82	126	6.5	10.31	5			70:17	11:15	38.7:20
	H16	4 Jun 83	148	9.0	12.16	7			84:35	7:29	38.3:28
	H16	12 Jun 83	127	8.0	12.59	6			60:24	5:18	37.8:19
	H16	20 Jun 83	126	7.0	11.11	14			66:26	8:27	38.2:27
	H16	12 Aug 83	130	5.2	8.00	6			65:26	10:24	39.2:27
	H18	30 Jun 83	131	6.8	10.38	9			64:20	7:28	40.2:24
	H21	24 Jul 83	145	7.0	9.65	10			48:27	10:35	39.1:32
	H21	5 Aug 83	144	7.5	10.41	9			56:29	10:27	39.7:31
	S1	17 Jun 81	125	8.5	13.60	7			58:14	18:08	
	S1	26 Jul 82	156	8.5	10.89	12			54:32	16:	39.0:
				1.0	1.28						
	S2	30 May 83	130	6.8	10.46	12			39:31	61:36	39.4:54
				2.0	3.08						
	S3	15 Jun 83	124	7.9	12.74	19			78:43	12:36	38.4:44
Adults	H1	13 Aug 80	153	4.8	6.27	9			46:	7:	37.9:
	H1	26 Jul 82	175	9.0	10.28	9			68:43	12:23	38.3:30
	H1	12 Jun 84	170	9.0	10.58	8			48:43	12:53	37.9:41

Appendix 2. (Continued).

Age-class	Bear	Date	Wt (kg)	Drug Amt		Time (min)[a]			Heart[c]	Resp[c]	Temp[c]
				cc	mg/kg[b]	Ind	Add	Down			
	H3	28 Aug 80	166	6.6	7.95	76		215	54:	14:	39.1:
				2.0	2.41		46				
				2.0	2.41		68				
	H5	5 Sep 80	185	5.0	5.40	16			54:50	12:53	38.9:57
				3.0	3.24		15				
	H5	26 Oct 80		9.0		20					37.7:26
	H7	9 Aug 81	186	11.3	12.15	5			33:39	9:	39.1:59
	H7	26 Sep 81	214	12.4	11.58	14			52:32	8:30	
	H14	20 Jul 83	137	8.0	11.67	18			80:26	7:28	38.8:26
	H15	26 May 83	178	12.0	13.48	13		157	62:37	18:38	
				1.5	1.69		32				
	H17	13 Jun 83	203	8.0	7.88	22		212	84:49	5:58	39.1:58
				2.0	1.97		24				
	H19	22 Jul 83	164	6.8	8.29	6			72:27	20:32	38.8:29
				1.0	1.22		10				
	H19	24 Aug 83	173	8.6	9.94	6			68:36	10:25	38.8:31
				1.0	1.16		15				
	K1	27 Jun 82	195	5.2	5.33	5			42:35	8:40	38.6:42
				2.7	2.77		22				

[a]Ind: Induction time measured from initial injection until bear was immobilized. Add: Time of additional injections measured from initial injection. Down: Length of time bear remained immobilized.

[b]Dosage in mg of each drug/kg bear weight.

[c]Heart rate in beats/minute, respiration rate in breaths/minute, rectal temperature in C, and each followed by time of measurement in minutes since initial injection.

Appendix 3. List of individual weights and body measurements of male grizzly bears captured in Kananaskis Country, Alberta.

Bear	Date	Age	Wt (kg)	Circumference			Zygo-matic width (cm)	Shoulder height (cm)	Total length (cm)	Pad (mm)	
				Head (cm)	Neck (cm)	Chest (cm)				Width (frt:hind)	Length (frt:hind)
S2	30 May 83	3	130	67	67	117	20.8	96	198	135:122	85:173
H10	26 Jun 82	3	178	73	70	124	21	112	192	145:135	86:180
H16	4 Jun 83	3	148	67	66	107	18.8	97	183	135:131	83:155
H16	12 Jun 83	3	127	65	62	101	19.1	103	186	142:129	88:173
H16	20 Jun 83	3	126	65	64	103	18.5	96	183	138:130	81:178
H18	30 Jun 83	3	131	65	64	105	19.7	94	183	124:120	61:167
S3	15 Jun 83	3	124	64	62	110	17.3	89		124:120	64:163
H16	12 Aug 83	3	130	63	64	105	19.2	96	187	138:128	81:180
H10	7 Oct 82	3	207								
S1	17 Jun 81	4	125	64	65	108	18.7	95	185	126:115	70:186
H2	14 Aug 80	4	104	64	60	97	19.0	83	175	127:114	62:160
H6	3 Jul 81	5	129	67	63	100	20.0	99	203	135:127	76:186
H21	24 Jul 83	5	145	69	71	115	21.2	98	183	133:120	74:177
S1	26 Jul 82	5	156	67	67	103	19.5	99	198	128:117	75:183
H14	5 Aug 82	5	124	63	65	99	19.5	94	164	123:125	71:173
H14	12 Aug 82	5	126	61	61	99	18.8	93	166	125:124	75:172
H21	5 Aug 83	5	144	67	70	112	19.5	96	181	128:120	66:173
H17	13 Jun 83	6	203	76	83	125	23.5	115	202	150:143	91:190
H14	20 Jul 83	6	137	67	64	109	20.2	94	166	132:123	68:177
H19	22 Jul 83	7	164	73	72	113	21.2	101	208	137:134	78:180
H19	24 Aug 83	7	173	75	74	113	21.6	100	210	138:138	86:184
K1	27 Jun 82	8	195	75	72	123	23.5	99	203	137:129	69:173
H3	28 Aug 80	9	166	65	69	117	21.0	103	195	130:120	74:180
H1	13 Aug 80	12	153	76	73	114	24.8	93	203	145:135	83:175
H1	26 Jul 82	14	175	74	78	124	24.3	103	200	141:125	77:188
H5	5 Sep 80	14	185	70	70	123	25.4	108	218	151:139	86:190
H5	26 Oct 80	14		72	77	137	23.5		175	144:141	86:190

Appendix 3. (Continued).

Bear	Date	Age	Wt (kg)	Circumference			Zygo-matic width (cm)	Shoulder height (cm)	Total length (cm)	Pad (mm)	
				Head (cm)	Neck (cm)	Chest (cm)				Width (frt:hind)	Length (frt:hind)
H15	26 May 83	15	178								
H7	9 Aug 81	15	186	73	76	125	25.0	102	190	142:129	88:177
H7	26 Sep 81	15	214		78	128	25.0	109	213	139:125	85:181
H1	12 Jun 84	16	170	73	74	116	22.0	105	189	133:121	71:162

Appendix 4. List of individual weights and body measurements of female grizzly bears captured in Kananaskis Country, Alberta.

Bear	Date	Age	Wt (kg)	Circumference			Zygo-matic width (cm)	Shoulder height (cm)	Total length (cm)	Pad (mm)	
				Head (cm)	Neck (cm)	Chest (cm)				Width (frt:hind)	Length (frt:hind)
H11	8 Jul 82	2	93	53	53	89	16.7	85	163	113:108	58:147
H12	11 Jul 82	2	94	52	51	84	17.3	82	153	119:109	58:147
H12	26 Jul 82	2	87	52	51	85	17.3	80	156	102:109	47:140
H11	13 Aug 82	2	88	56	57	88	17.0	75	164	110:105	63:141
H11	6 Jun 83	3	88	59	55	96	17.0	70	167	113:102	51:143
H11	18 Jun 83	3	91	59	53	90	17.6	86	163	118:109	62:150
H13	15 Jul 82	6	124	61	64	103	19.5	94	173	122:115	76:160
H4	29 Aug 80	6	121	61	60	102	18.6	99	175	119:112	76:163
H8	19 Aug 81	6	109	58	53	93	18.8	86	181	114:107	62:147
H20	24 Jul 83	10	104	62	57	96	18.9	88	182	120:114	63:163
H9	13 Sep 81	14	109	61	69	106	18.7	85	161	117:109	63:153
H9	1 Jul 82	15	106	65	60	97	19.2	80	173	115:113	67:154
H9	12 Jul 82	15	106	65	60	97	19.2	80	173	115:113	67:154
H9	26 Jul 82	15	108	59	60	96	19.3	81	166	124:117	82:152